



# UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE  
United States Patent and Trademark Office  
Address: COMMISSIONER FOR PATENTS  
P.O. Box 1450  
Alexandria, Virginia 22313-1450  
www.uspto.gov

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
-----------------	-------------	----------------------	---------------------	------------------

10/680,260

10/08/2003

David William Abraham

YOR920030013US1

5657

48150

7590

09/11/2008

MCGINN INTELLECTUAL PROPERTY LAW GROUP, PLLC  
8321 OLD COURTHOUSE ROAD  
SUITE 200  
VIENNA, VA 22182-3817

EXAMINER

MAI, ANH D

ART UNIT

PAPER NUMBER

2814

MAIL DATE

DELIVERY MODE

09/11/2008

PAPER

**Please find below and/or attached an Office communication concerning this application or proceeding.**

The time period for reply, if any, is set in the attached communication.

<b>Office Action Summary</b>	<b>Application No.</b> 10/680,260	<b>Applicant(s)</b> ABRAHAM ET AL.	
	<b>Examiner</b> Anh D. Mai	<b>Art Unit</b> 2814	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

### Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

### Status

- 1) ☒ Responsive to communication(s) filed on 27 May 2008.
- 2a) ☐ This action is **FINAL**.                      2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

### Disposition of Claims

- 4) ☒ Claim(s) 1, 2, 5, 6, 8, 9, 11, 12, 14-23, 25 and 26 is/are pending in the application.
- 4a) Of the above claim(s) \_\_\_\_\_ is/are withdrawn from consideration.
- 5) ☐ Claim(s) \_\_\_\_\_ is/are allowed.
- 6) ☒ Claim(s) 1, 2, 5, 6, 8, 9, 11, 12, 14-23, 25 and 26 is/are rejected.
- 7) ☐ Claim(s) \_\_\_\_\_ is/are objected to.
- 8) ☐ Claim(s) \_\_\_\_\_ are subject to restriction and/or election requirement.

### Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on \_\_\_\_\_ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.  
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).  
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

### Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All    b) ☐ Some \*    c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
  2. ☐ Certified copies of the priority documents have been received in Application No. \_\_\_\_\_.
  3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

\* See the attached detailed Office action for a list of the certified copies not received.

### Attachment(s)

- |  |   |
|--|---|
| 1) <input checked="" type="checkbox"/> Notice of References Cited (PTO-892)          | 4) <input type="checkbox"/> Interview Summary (PTO-413)           |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948) | Paper No(s)/Mail Date. _____                                      |
| 3) <input type="checkbox"/> Information Disclosure Statement(s) (PTO/SB/08)          | 5) <input type="checkbox"/> Notice of Informal Patent Application |
| Paper No(s)/Mail Date _____  | 6) <input type="checkbox"/> Other: _____                          |

## **DETAILED ACTION**

### ***Continued Examination Under 37 CFR 1.114***

1. A request for continued examination under 37 CFR 1.114, including the fee set forth in 37 CFR 1.17(e), was filed in this application after final rejection. Since this application is eligible for continued examination under 37 CFR 1.114, and the fee set forth in 37 CFR 1.17(e) has been timely paid, the finality of the previous Office action has been withdrawn pursuant to 37 CFR 1.114. Applicant's submission filed on May 27, 2008 has been entered.

### ***Status of the Claims***

2. The Amendment filed May 27, 2008 has been entered. Claims 1, 8 and 9 have been amended. Claims 7, 10 and 13 have been cancelled. Claims 1, 2, 5, 6, 8, 9, 11, 12, 14-23, 25 and 26 are pending.

### ***Specification***

3. Amendment to the specification filed May 27, 2008 is acknowledged.

### ***Claim Objections***

4. Claims 8 and 9 are objected to under 37 CFR 1.75(c), as being of improper dependent form for failing to further limit the subject matter of a previous claim. Applicant is required to cancel the claim(s), or amend the claim(s) to place the claim(s) in proper dependent form, or rewrite the claim(s) in independent form.

Claim 1 recites the transformed portion **to be non-magnetic and electrically insulating**.

Art Unit: 2814

Since the applicant already equates “magnetic” to be “ferromagnetic” then “non-magnetic” is “non-ferromagnetic”. Therefore, claim 8 fails to further limit claim 1.

Similarly, claim 9 fails to further limit claim 1 because the transformed portion of claim 1 is already non-magnetic.

### ***Claim Rejections - 35 USC § 112***

The following is a quotation of the first paragraph of 35 U.S.C. 112:

The specification shall contain a written description of the invention, and of the manner and process of making and using it, in such full, clear, concise, and exact terms as to enable any person skilled in the art to which it pertains, or with which it is most nearly connected, to make and use the same and shall set forth the best mode contemplated by the inventor of carrying out his invention.

5. Claims 1, 2, 5, 6, 8, 9, 11, 12, 14-23, 25 and 26 (all pending claims) are rejected under 35 U.S.C. 112, first paragraph, as failing to comply with the written description requirement. The claim(s) contains subject matter which was not described in the specification in such a way as to reasonably convey to one skilled in the relevant art that the inventor(s), at the time the application was filed, had possession of the claimed invention.

There does not appear to be a written description of the claim limitation “said **magnetic thin film comprises Ni<sub>0.8</sub>Fe<sub>0.2</sub>**” in the application as filed.

At best, the specification discloses the magnetic thin film being: “(e.g., Permalloy<sup>TM</sup>, alloy of nickel, iron and cobalt) or (e.g., Permalloy<sup>TM</sup>, NiFe, etc.)”.

Therefore, the “magnetic thin film comprises **Ni<sub>0.8</sub>Fe<sub>0.2</sub>**” is a new matter.

Applicant must cancel the new matter in response to this office action.

The following is a quotation of the second paragraph of 35 U.S.C. 112:

Art Unit: 2814

The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

6. Claims 8, 16, 18, 20 and 21 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

With respect to claim 8, Claim 8 recites the limitation "wherein said fluorine-containing film is non-**ferromagnetic**" in lines 1-2. There is insufficient antecedent basis for this limitation in the claim.

Since the thin film of claim 1 a **magnetic** thin film, therefore, claim 8 *lacks antecedent basis* because a magnetic thin film is converted to non-magnetic thin film, not non-ferromagnetic.

With respect to claim 16, the limitation of claim 16 includes: the method of claim 1, **wherein said reactive plasma includes argon.**

However, claim 1 recites: "said chemical transformation comprises using a **fluorine-based** reactive plasma.

Argon is not **fluorine**-based. Therefore, claim 16 is indefinite.

With respect to claim 18, the limitation of claim 18 includes: the method of claim 1, **wherein said reactive plasma includes bromide.**

However, claim 1 recites: "said chemical transformation comprises using a **fluorine-based** reactive plasma.

Bromide is not **fluorine**-based. Therefore, claim 16 is indefinite.

With respect to claim 20, Claim 8 recites the limitation "forming an insulating layer over the converted portion of said magnetic thin film and **said mask;**" in lines 23. (emphasis added). There is insufficient antecedent basis for this limitation, said mask, in the claim.

### ***Claim Rejections - 35 USC § 103***

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

7. Claims 1, 2, 5-6, 8, 9, 11, 14, 15, 17-19, 22, 23, 25 and 26 are rejected under 35 U.S.C. 103(a) as being unpatentable over Kamata et al. (U.S. Pub. No. 2002/0142192) of record, in view of Kitada et al. (US Patent No. 4,411,757).

With respect to claim 1, as best understood by Examiner, Kamata teaches method of patterning a magnetic thin film substantially as claimed including:

transforming a portion of the magnetic thin film (20, 330, 350) to be non-magnetic and electrically insulating (40, 370) using a chemical transformation, the chemical transformation comprises using a fluorine-based reactive plasma, wherein the portion of the magnetic thin film (20, 330, 350) comprises NiFe and the transforming comprises transforming the NiFe to fluorine-containing film, and wherein the fluorine-containing film (40, 370) is electrically insulating. (See Figs. 3A-B, 13A-B).

Thus Kamata is shown to teach all the features of the claim with the exception of explicitly disclosing the NiFe magnetic thin film being  $\text{Ni}_{0.8}\text{Fe}_{0.2}$ .

However, Kitada teaches a Ni-Fe alloy magnetic thin film including  $\text{Ni}_{0.8}\text{Fe}_{0.2}$  is well known in the art for its high magnetic permeability, low coercivity, significant anisotropic magnetoresistance and most importantly, its ability to be converted to non-magnetic by a chemical reaction.

Therefore, it would have been obvious to one having ordinary skill in the art at the time of invention was made to pattern the magnetic thin film of Kamata by utilizing magnetic film comprising  $\text{Ni}_{0.8}\text{Fe}_{0.2}$  as taught by Kitada for its characteristics and its ability to be converted to non-magnetic by chemical reaction.

With respect to claim 2, the method of Kamata further includes: providing a mask (30, 360) over the portion of the magnetic thin film (20) to be preserved using photolithography.

With respect to claim 5, the fluorine-based reactive plasma of Kamata  $\text{CF}_4$ ,  $\text{SF}_6$ ,  $\text{CHF}_3$ .

With respect to claim 6, the pressure used in the converting of Kamata is within a range of about 10 mT to about 30 mT.

With respect to claim 8, as best understood by Examiner, the fluorine-containing film (40) is non-ferromagnetic.

With respect to claim 9, as best understood by Examiner, the fluorine-containing film (40) of Kamata is non-magnetic.

With respect to claim 11, the mask (30) of Kamata comprises a photoresist.

Art Unit: 2814

With respect to claim 14, the using chemical transformation of Kamata can be performed at room temperature.

With respect to claim 15, the reactive plasma of Kamata includes a fluorocarbon.

With respect to claim 17, the reactive plasma of Kamata includes sulfur hexafluoride.

With respect to claim 18, as best understood by Examiner, Kamata teaches converting a portion of the magnetic thin film (20) into non-magnetic insulating (40) using fluorine-based reactive plasma.

Thus, Kamata is shown to teach all the features of the claim with the exception of explicitly utilizing reactive plasma including bromide.

However, Kamata teaches the chemical transformation utilizing reactive gas containing halide. It is well known that bromide is a member of halide gas.

Therefore, absent unexpected result, it would have been obvious to one having ordinary skill in the art at the time of invention to chemically transform the portion of the magnetic thin film of Kamata utilizing bromide, since bromide as well as iodide, fluoride or chloride are member of reactive gas known as halide.

With respect to claim 19, the pressure of Kamata is selectively employed for the plasma sputtering such that the magnetic thin film material (20) is substantially free of erosion.

With respect to claim 22, the mask of Kamata comprises an insulating hard mask (30, 360), the method of Kamata further includes: after the converting, selectively etching the insulating hard mask (30, 360) to remove the insulating hard mask.



Art Unit: 2814

With respect to claim 23, the method of Kamata further includes: forming a conductive material (380) over the area where the insulating hard mask (360) was etched.

With respect to claim 25, the magnetic thin film (20) of Kamata includes a magnetic tunnel junction (MTJ), and wherein after the converting portion, the edges of the magnetic tunnel junction have no exposure to oxygen. (see Figs 3C, 13B).

With respect to claim 26, the edge smoothness of the MTJ of Kamata is inherently determined by a line edge roughness of the mask (30, 360).

8. Claim 12 is rejected under 35 U.S.C. 103(a) as being unpatentable over Kamata '192 and Kitada '757 as applied to claim 2 above, and further in view of Ning et al. (U.S. Pub. No. 2002/0098676) of record.

With respect to claim 12, Kamata teaches providing a mask over a portion of the magnetic thin film for patterning.

Thus, Kamata and Kitada are shown to teach all the features of the claim with the exception of utilizing a metal hard mask.

However, Ning teaches utilizing photolithography to provide a mask including TaN, TiN (244) for patterning.

Therefore, it would have been obvious to one having ordinary skill in the art at the time of invention to provide a hard mask of Kamata including a TiN and TaN as taught by Ning for patterning over the portion of the magnetic thin film.

Art Unit: 2814

9. Claim 16 is rejected under 35 U.S.C. 103(a) as being unpatentable over Kamata and Kitada as applied to claim 1 above, and further in view of Baglin et al. (U.S. Patent No. 6,331,364) of record.

As best understood by Examiner, Kamata teaches converting a portion of a magnetic thin film by the fluorine-based reactive plasma.

Thus, Kamata is shown to teach all the features of the claim with the exception of using the reactive plasma including argon.

However, Baglin teaches other ion species that may be used to converting a magnetic thin film including argon. (See col. 10, lines 9-13).

Therefore, it would have been obvious to one having ordinary skill in the art at the time of invention was made to convert a portion of the magnetic thin film of Kamata utilizing argon plasma as taught by Baglin to achieve the same desired purpose, chemical conversion.

10. Claims 20 and 21 are rejected under 35 U.S.C. 103(a) as being unpatentable over Kamata and Kitada as applied to claim 1 above, and further in view of Chen et al. (U.S. Patent No. 6,165,803) of record.

With respect to claim 20, as best understood by Examiner, Kamata teaches converting a portion of magnetic thin film (20) by fluorine-based reactive plasma.

Thus, Kamata and Kitada are shown to teach all the features of the claim with the exception of including further process steps.

However, Chen teaches process steps following the conversion including:

Art Unit: 2814

forming an insulating layer (72) over the converted portion (42b) of the magnetic thin film (42) and the mask (52); and  
etching the insulating layer (72) and the mask (52) to planarize the upper level of the mask (52) and the insulating layer (72). (See Fig. 12).

Therefore, it would have been obvious to one having ordinary skill in the art at the time of invention was made to include further process after convert the magnetic thin film of Kamata as taught by Chen to form the MTJ device.

With respect to claim 21, the method of Chen, further includes:

selectively etching the mask (52); and forming a conductive material (70) over the insulating layer (72) and the area where the mask (52) was selectively etched. (See Fig. 13).

### ***Response to Arguments***

11. Applicant's arguments with respect to amended claims have been considered but are moot in view of the new ground(s) of rejection.

### ***Conclusion***

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Anh D. Mai whose telephone number is (571) 272-1710. The examiner can normally be reached on 8:00AM-5:00PM.

Art Unit: 2814

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Wael Fahmy can be reached on (571) 272-1705. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

/Anh D. Mai/

Primary Examiner, Art Unit 2814